

Draft

**Procedure Related to Corrective Action for Systems Not
Currently Providing Minimum Treatment**

Ministry of the Environment

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Introduction

For all drinking water systems under Ontario Regulation xxx/03, specified minimum treatment capability is required by various deadlines which extend between July 1, 2003 and Dec. 31, 2006.

This document provides alternate procedures to address certain adverse sample results related to microbiological and turbidity test results from Ontario Regulation xxx/03 systems that are presently not providing minimum treatment. These procedures should be used only when Ontario Regulation xxx/00 allows for their use. All other activities under the regulation remain unchanged.

The availability of these alternative procedures provides several options for corrective action for owners of Ontario Regulation xxx/03 systems.

I: **Ground Water Systems - Corrective Action for Schedule 10 - 1 Microbiological Indicators of Adverse Water Quality in Ontario Regulation xxx/03**

Follow the corrective actions below. The corrective actions are keyed to the numbered Indicators of Adverse Water Quality in Schedule 10 - 1 of Ontario Regulation xxx/03. There are no corrective actions here for Indicators 1, 6, 7, 8 and 10; for these indicators, the corrective actions indicated in Schedules 11 - 1 and 11 - 2 should be followed.

Indicator 2 - E. coli

Escherichia coli (E. coli) or fecal coliform is detected in any required sample of drinking water.

Procedure

Immediately stop all use of water or ensure that all consumers are immediately notified that water intended for human consumption should be brought to a rapid rolling boil for at least one minute.

Notify the local Medical Officer of Health and the Spills Action Centre of the Ministry of the Environment of the adverse test results as required in O. Reg xxx/03.

Conduct an inspection of the well head and distribution system to ensure that the works has been properly constructed and maintained to prevent entry of contamination (see Appendix A - Well System Checklist). Correct any problems before resuming normal use of the water.

Ensure that bacterial contamination is eliminated from the system through temporary disinfection, flushing of the lines, and resampling of the system (see below).

If bacteria are still present following temporary system disinfection, consult a trained professional. Consultation should include a site visit and consideration of the following factors (also, see Appendix B - List of Questions for Use in On-site Investigation):

- Potential sources of contamination
- Most efficient means of delivering safe drinking water for the long-term
- Health protection of the users who are served by the system

The owner of the drinking water system has the following options:

- Continued use of the existing works following successful temporary system disinfection;
- Continued use of the existing system following the installation and operation of permanent disinfection equipment in accordance with regulatory minimum treatment requirements. Various devices are available for this purpose, including point-of-entry devices;
- Disconnection from the existing source well and construction of a new source well;
- Disconnection from the existing source well and connection to a regulated non-municipal drinking water system that is currently providing minimum treatment and has the operational capacity to handle the additional demand; or
- Disconnection from the existing well and connection to a municipal drinking water system that is currently providing minimum treatment.

Corrective action should be continued until E. coli and fecal coliforms are not detected in two consecutive sets of samples. The local Medical Officer of Health may give further instructions and may authorize resumption of normal use of the water.

Resampling

Resampling should consist of a minimum of three samples to be collected for each sampling site where a positive sample was taken: one sample at the site; one at an adjacent location on the same distribution line; and a third some distance upstream toward the water source.

Temporary System Disinfection

For the purposes of temporary disinfection, water distribution systems that serve more than one building should have functional stand-by chlorination equipment, including a pump, solution tank, a fresh supply of chemical disinfectant, and a means to detect chlorine residual. If the owner of such a water distribution system intends to continue the use of the existing works without installing permanent treatment equipment, then installation of basic stand-by chlorination equipment is advised.

If necessary, temporary disinfection can be effectively carried out without stand-by chlorination equipment (see Appendix C - Procedure for Manual Disinfection of a Ground Water System). In all cases, ensure that temporary system disinfection involves the following steps:

- Use a fresh supply of chemical disinfectant

- Disinfect the system such that a free chlorine residual of 50 mg/L can be detected at all points in the affected part(s) of the distribution system and plumbing for at least 12 hours
- Flush the water distribution system and plumbing with water to ensure the chlorine is removed from the system
- Resample and analyze 48 hours after flushing

Temporary system disinfection should be repeated until the relevant indicator of adverse water quality is not detected in two consecutive sets of samples.

Do not resume normal use of the water until authorized by the local Medical Officer of Health.

Immediate Provision of Minimum Treatment

It is the Ministry's position that there is virtually no alternative to the immediate provision of minimum treatment if, on two separate occasions in a 24 month period:

- Escherichia coli (E. coli) or fecal coliform is detected in any required sample of drinking water.

If an owner disconnects from the existing well and is actively pursuing options for a different source of supply, as discussed above, the immediate provision of minimum treatment may not be warranted. The owner must ensure that all abandoned wells are plugged and sealed according to the requirements of Regulation 903.

Indicator 3 - Total Coliforms

Total coliforms are detected (but Escherichia coli or other fecal coliforms are not detected) in any required sample of drinking water.

Procedure

Immediately resample at the same site and analyze. If confirmed to be positive, stop all use of water or ensure that all consumers are immediately notified that water intended for human consumption should be brought to a rapid rolling boil for at least one minute.

Notify the local Medical Officer of Health and the Spills Action Centre of the Ministry of the Environment of the adverse test results as required in O.Reg xxx/03.

Conduct an inspection of the well head and distribution system to ensure that the works has been properly constructed and maintained to prevent entry of

contamination (see Appendix A - Well System Checklist). Correct any problems before resuming normal use of the water.

Ensure that bacterial contamination is eliminated from the system through temporary disinfection, flushing of the lines, and resampling of the system (see below).

If bacteria are still present following temporary system disinfection, consult a trained professional. Consultation should include a site visit and consideration of the following factors (also, see Appendix B - List of Questions for Use in On-site Investigation):

- Potential sources of contamination
- Most efficient means of delivering safe drinking water for the long-term
- Health protection of the users who are served by the system

The owner of the drinking water system has the following options:

- Continued use of the existing works following successful temporary system disinfection;
- Continued use of the existing system following the installation and operation of permanent disinfection equipment in accordance with regulatory minimum treatment requirements. Various devices are available for this purpose, including point-of-entry devices;
- Disconnection from the existing source well and construction of a new source well;
- Disconnection from the existing source well and connection to a regulated non-municipal drinking water system that is currently providing minimum treatment and has the operational capacity to handle the additional demand; or
- Disconnection from the existing well and connection to a municipal drinking water system that is currently providing minimum treatment.

Corrective action should be continued until total coliforms are not detected in two consecutive sets of samples. The local Medical Officer of Health may give further instructions and may authorize resumption of normal use of the water.

Resampling

Resampling should consist of a minimum of three samples to be collected for each sampling site where a positive sample was taken: one sample at the site; one at an adjacent location on the same distribution line; and a third some distance upstream toward the water source.

Temporary System Disinfection

For the purposes of temporary disinfection, water distribution systems that serve more than one building should have functional stand-by chlorination equipment, including a pump, solution tank, a fresh supply of chemical disinfectant, and a means to detect chlorine residual. If the owner of such a water distribution system intends to continue the use of the existing works without installing permanent treatment equipment, then installation of basic stand-by chlorination equipment is advised.

If necessary, temporary disinfection can be effectively carried out without stand-by chlorination equipment (see Appendix C - Procedure for Manual Disinfection of a Ground Water System). In all cases, ensure that temporary system disinfection involves the following steps:

- Use a fresh supply of chemical disinfectant
- Disinfect the system such that a free chlorine residual of 50 mg/L can be detected at all points in the affected part(s) of the distribution system and plumbing for at least 12 hours
- Flush the water distribution system and plumbing with water to ensure the chlorine is removed from the system
- Resample and analyze 48 hours after flushing

Temporary system disinfection should be repeated until the relevant indicator of adverse water quality is not detected in two consecutive sets of samples.

Do not resume normal use of the water until authorized by the local Medical Officer of Health.

Immediate Provision of Minimum Treatment

It is the Ministry's position that there is virtually no alternative to the immediate provision of minimum treatment if, on 3 separate occasions in a 24 month period:

- any sample of water contains more than 10 coliform organisms per 100 mL (none of which are fecal coliforms or E. coli); or
- Total coliforms are detected (but *Escherichia coli* or other fecal coliforms are not detected) in any sample of water and temporary system disinfection does not immediately eliminate these coliform organisms from resamples¹.

¹ Based on Health Canada's conditions for compliance with coliform MAC - "Guidelines for Canadian Drinking Water Quality", 6th Ed 1996

If an owner disconnects from the existing well and is actively pursuing options for a different source of supply, as discussed above, the immediate provision of minimum treatment may not be warranted. The owner must ensure that all abandoned wells are plugged and sealed according to the requirements of Regulation 903.

Indicator 4 - Heterotrophic Plate Count

More than 500 colonies per millilitre are detected on a heterotrophic plate count analysis (but *Escherichia coli* or other fecal coliforms are not detected) in any required sample of drinking water.

Procedure

Immediately resample at the same site and analyze. If confirmed to be positive, stop all use of water or ensure that all consumers are immediately notified that water intended for human consumption should be brought to a rapid rolling boil for at least one minute.

Notify the local Medical Officer of Health and the Spills Action Centre of the Ministry of the Environment of the adverse test results as required in O. Reg xxx/03.

Conduct an inspection of the well head and distribution system to ensure that the works has been properly constructed and maintained to prevent entry of contamination (see Appendix A - Well System Checklist). Correct any problems before resuming normal use of the water.

Ensure that bacterial contamination is eliminated from the system through temporary disinfection, flushing of the lines, and resampling of the system (see below).

If bacteria are still present following temporary system disinfection, consult a trained professional. Consultation should include a site visit and consideration of the following factors (also, see Appendix B - List of Questions for Use in On-site Investigation):

- Potential sources of contamination
- Most efficient means of delivering safe drinking water for the long-term
- Health protection of the users who are served by the system

The owner of the drinking water system has the following options:

- Continued use of the existing works following successful temporary system disinfection;

- Continued use of the existing system following the installation and operation of permanent disinfection equipment in accordance with regulatory minimum treatment requirements. Various devices are available for this purpose, including point-of-entry devices;
- Disconnection from the existing source well and construction of a new source well;
- Disconnection from the existing source well and connection to a regulated non-municipal drinking water system that is currently providing minimum treatment and has the operational capacity to handle the additional demand; or
- Disconnection from the existing well and connection to a municipal drinking water system that is currently providing minimum treatment.

Corrective action should be continued until the indicator of adverse water quality is less than 500 colonies per millilitre on a heterotrophic plate count analysis in two consecutive sets of samples. The local Medical Officer of Health may give further instructions and may authorize resumption of normal use of the water.

Resampling

Resampling should consist of a minimum of three samples to be collected for each sampling site where a positive sample was taken: one sample at the site; one at an adjacent location on the same distribution line; and a third some distance upstream toward the water source.

Temporary System Disinfection

For the purposes of temporary disinfection, water distribution systems that serve more than one building should have functional stand-by chlorination equipment, including a pump, solution tank, a fresh supply of chemical disinfectant, and a means to detect chlorine residual. If the owner of such a water distribution system intends to continue the use of the existing works without installing permanent treatment equipment, then installation of basic stand-by chlorination equipment is advised.

If necessary, temporary disinfection can be effectively carried out without stand-by chlorination equipment (see Appendix C - Procedure for Manual Disinfection of a Ground Water System). In all cases, ensure that temporary system disinfection involves the following steps:

- Use a fresh supply of chemical disinfectant
- Disinfect the system such that a free chlorine residual of 50 mg/L can be detected at all points in the affected part(s) of the distribution system and plumbing for at least 12 hours

- Flush the water distribution system and plumbing with water to ensure the chlorine is removed from the system
- Resample and analyze 48 hours after flushing

Temporary system disinfection should be repeated until the indicator of adverse water quality is less than 500 colonies per millilitre on a heterotrophic plate count analysis in two consecutive sets of samples.

Do not resume normal use of the water until authorized by the local Medical Officer of Health.

Immediate Provision of Minimum Treatment

It is the Ministry's position that there is virtually no alternative to the immediate provision of minimum treatment if, on 3 separate occasions in a 24 month period:

- More than 500 colonies per millilitre are detected on a heterotrophic plate count analysis (but Escherichia coli or other fecal coliforms are not detected) in any required sample of drinking water.

If an owner disconnects from the existing well and is actively pursuing options for a different source of supply, as discussed above, the immediate provision of minimum treatment may not be warranted. The owner must ensure that all abandoned wells are plugged and sealed according to the requirements of Regulation 903.

Indicator 5 - Background Colonies

More than 200 background colonies are detected on a total coliform membrane filter analysis in any required sample of drinking water.

Procedure

Immediately resample at the same site and analyze. If confirmed to be positive, stop all use of water or ensure that all consumers are immediately notified that water intended for human consumption should be brought to a rapid rolling boil for at least one minute.

Notify the local Medical Officer of Health and the Spills Action Centre of the Ministry of the Environment of the adverse test results as required in O. Reg xxx/03.

Conduct an inspection of the well head and distribution system to ensure that the works has been properly constructed and maintained to prevent entry of contamination (see Appendix A - Well System Checklist). Correct any problems before resuming normal use of the water.

Ensure that bacterial contamination is eliminated from the system through temporary disinfection, flushing of the lines, and resampling of the system (see below).

If bacteria are still present following temporary system disinfection, consult a trained professional. Consultation should include a site visit and consideration of the following factors (also, see Appendix B - List of Questions for Use in On-site Investigation):

- Potential sources of contamination
- Most efficient means of delivering safe drinking water for the long-term
- Health protection of the users who are served by the system

The owner of the drinking water system has the following options:

- Continued use of the existing works following successful temporary system disinfection;
- Continued use of the existing system following the installation and operation of permanent disinfection equipment in accordance with regulatory minimum treatment requirements. Various devices are available for this purpose, including point-of-entry devices;
- Disconnection from the existing source well and construction of a new source well;
- Disconnection from the existing source well and connection to a regulated non-municipal drinking water system that is currently providing minimum treatment and has the operational capacity to handle the additional demand; or
- Disconnection from the existing well and connection to a municipal drinking water system that is currently providing minimum treatment.

Corrective action should continue until the indicator of adverse water quality is less than 200 colonies on a total coliform membrane filter analysis in two consecutive sets of samples. The local Medical Officer of Health may give further instructions and may authorize resumption of normal use of the water.

Resampling

Resampling should consist of a minimum of three samples to be collected for each sampling site where a positive sample was taken: one sample at the site; one at an adjacent location on the same distribution line; and a third some distance upstream toward the water source.

Temporary System Disinfection

For the purposes of temporary disinfection, water distribution systems that serve more than one building should have functional stand-by chlorination equipment, including a pump, solution tank, a fresh supply of chemical disinfectant, and a means to detect chlorine residual. If the owner of such a water distribution system intends to continue the use of the existing works without installing permanent treatment equipment, then installation of basic stand-by chlorination equipment is advised.

If necessary, temporary disinfection can be effectively carried out without stand-by chlorination equipment (see Appendix C - Procedure for Manual Disinfection of a Ground Water System). In all cases, ensure that temporary system disinfection involves the following steps:

- Use a fresh supply of chemical disinfectant
- Disinfect the system such that a free chlorine residual of 50 mg/L can be detected at all points in the affected part(s) of the distribution system and plumbing for at least 12 hours
- Flush the water distribution system and plumbing with water to ensure the chlorine is removed from the system
- Resample and analyze 48 hours after flushing

Temporary system disinfection should be repeated until the indicator of adverse water quality is less than 200 colonies on a total coliform membrane filter analysis in two consecutive sets of samples. The local Medical Officer of Health may give further instructions and may authorize resumption of normal use of the water.

Do not resume normal use of the water until authorized by the local Medical Officer of Health.

Immediate Provision of Minimum Treatment

It is the Ministry's position that there is virtually no alternative to the immediate provision of minimum treatment if, on 3 separate occasions in a 24 month period:

- More than 200 background colonies are detected on a total coliform membrane filter analysis in any required sample of drinking water.

If an owner disconnects from the existing well and is actively pursuing options for a different source of supply, as discussed above, the immediate provision of minimum treatment may not be warranted. The owner must ensure that all abandoned wells are plugged and sealed according to the requirements of Regulation 903.

Indicator 9 - Aeromonas, etc.

Aeromonas spp., Pseudomonas aeruginosa, Staphylococcus aureus, Clostridium spp. or fecal streptococci (Group D streptococci) are detected in any required sample of drinking water.

Procedure

Immediately resample at the same site and analyze. If confirmed to be positive, stop all use of water or ensure that all consumers are immediately notified that water intended for human consumption should be brought to a rapid rolling boil for at least one minute.

Notify the local Medical Officer of Health and the Spills Action Centre of the Ministry of the Environment of the adverse test results as required in O. Reg xxx/03.

Conduct an inspection of the well head and distribution system to ensure that the works has been properly constructed and maintained to prevent entry of contamination (see Appendix A - Well System Checklist). Correct any problems before resuming normal use of the water.

Ensure that bacterial contamination is eliminated from the system through temporary disinfection, flushing of the lines, and resampling of the system (see below).

If bacteria are still present following temporary system disinfection, consult a trained professional. Consultation should include a site visit and consideration of the following factors (also, see Appendix B - List of Questions for Use in On-site Investigation):

- Potential sources of contamination
- Most efficient means of delivering safe drinking water for the long-term
- Health protection of the users who are served by the system

The owner of the drinking water system has the following options:

- Continued use of the existing works following successful temporary system disinfection;
- Continued use of the existing system following the installation and operation of permanent disinfection equipment in accordance with regulatory minimum treatment requirements. Various devices are available for this purpose, including point-of-entry devices;
- Disconnection from the existing source well and construction of a new source well;

- Disconnection from the existing source well and connection to a regulated non-municipal drinking water system that is currently providing minimum treatment and has the operational capacity to handle the additional demand; or
- Disconnection from the existing well and connection to a municipal drinking water system that is currently providing minimum treatment.

Corrective action should be continued until the indicator bacteria are not detected in two consecutive sets of samples. The local Medical Officer of Health may give further instructions and may authorize resumption of normal use of the water.

Resampling

Resampling should consist of a minimum of three samples to be collected for each sampling site where a positive sample was taken: one sample at the site; one at an adjacent location on the same distribution line; and a third some distance upstream toward the water source.

Temporary System Disinfection

For the purposes of temporary disinfection, water distribution systems that serve more than one building should have functional stand-by chlorination equipment, including a pump, solution tank, a fresh supply of chemical disinfectant, and a means to detect chlorine residual. If the owner of such a water distribution system intends to continue the use of the existing works without installing permanent treatment equipment, then installation of basic stand-by chlorination equipment is advised.

If necessary, temporary disinfection can be effectively carried out without stand-by chlorination equipment (see Appendix C - Procedure for Manual Disinfection of a Ground Water System). In all cases, ensure that temporary system disinfection involves the following steps:

- Use a fresh supply of chemical disinfectant
- Disinfect the system such that a free chlorine residual of 50 mg/L can be detected at all points in the affected part(s) of the distribution system and plumbing for at least 12 hours
- Flush the water distribution system and plumbing with water to ensure the chlorine is removed from the system
- Resample and analyze 48 hours after flushing

Temporary system disinfection should be repeated until the relevant indicator of adverse water quality is not detected in two consecutive sets of samples.

Do not resume normal use of the water until authorized by the local Medical Officer of Health.

Immediate Provision of Minimum Treatment

It is the Ministry's position that there is virtually no alternative to the immediate provision of minimum treatment if, on 3 separate occasions in a 24 month period:

- *Aeromonas* spp., *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Clostridium* spp. or *fecal streptococci* (Group D streptococci) are detected in any required sample of drinking water.

If an owner disconnects from the existing well and is actively pursuing options for a different source of supply, as discussed above, the immediate provision of minimum treatment may not be warranted. The owner must ensure that all abandoned wells are plugged and sealed according to the requirements of Regulation 903.

II: **Surface Water Systems - Corrective Action for Schedule 10 - 1
Microbiological and Turbidity Indicators of Adverse Water
Quality in Ontario Regulation xxx/03**

NOTE: It is not safe to drink untreated surface water. Minimum treatment including filtration and disinfection is required on all surface water systems by the required deadline.

Ground Water Directly Under the Influence of Surface Water

Systems that obtain water from a raw water supply which is ground water directly under the influence of surface water must follow the corrective action for surface water systems that are outlined here.

Ontario Regulation xxx/03 deems the following drinking water systems to be systems that obtain water from a raw water supply which is ground water directly under the influence of surface water, unless a report made by a professional engineer, hydrologist, geologist or hydrogeologist concludes otherwise:

1. A drinking-water system that obtains water from,
 - (i) a well which does not have watertight casing that extends to a depth of at least 6 metres below ground level; or,
 - (ii) an infiltration gallery
2. A drinking-water system, not capable of producing water at a rate of 250,000 Litres/day, that obtains water from a well, any part of which is within 15 metres of surface water.
3. A drinking-water system, capable of producing water at a rate of 250,000 Litres/day, that obtains water from an overburden well, any part of which is within 100 metres of surface water, and
4. A drinking-water system, capable of producing water at a rate of 250,000 Litres/day, that obtains water from a bedrock well, any part of which is within 500 metres of surface water,

Detection of Bacteria or Turbidity in Surface Water Systems

The following corrective action is required if a surface water system does not currently meet minimum treatment requirements and any of the following indicators of adverse water quality are revealed:

- Escherichia coli (E. coli) or fecal coliform is detected in any required sample of drinking water;

- Total coliforms are detected (but *Escherichia coli* or other fecal coliforms are not detected) in any required sample of drinking water;
- More than 500 colonies per millilitre are detected on a heterotrophic plate count analysis (but *Escherichia coli* or other fecal coliforms are not detected) in any required sample of drinking water;
- More than 200 background colonies are detected on a total coliform membrane filter analysis in any required sample of drinking water;
- *Aeromonas* spp., *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Clostridium* spp. or fecal streptococci (Group D streptococci) are detected in any required sample of drinking water; or
- Turbidity is more than 1.0 Nephelometric Turbidity Units (NTU) in any required sample.

Procedure

Immediately stop all use of water or ensure that all consumers are immediately notified that water intended for human consumption should be brought to a rapid rolling boil for at least one minute.

Notify the local Medical Officer of Health and the Spills Action Centre of the Ministry of the Environment of the adverse test results as required in O. Reg xxx/03.

Consult a trained professional. Consultation should include a site visit and consideration of the following factors (also, see Appendix B - List of Questions for Use in On-site Investigation):

- Potential sources of contamination
- Most efficient means of delivering safe drinking water for the long-term
- Health protection of the users who are served by the system

The owner of the drinking water system has the following options:

- Continued use of the existing system following the installation and operation of permanent filtration and disinfection equipment in accordance with regulatory minimum treatment requirements. Various devices are available for some of these purposes, including point-of-entry devices;
- Disconnection from the existing source intake and construction of a new source well;
- Disconnection from the existing source intake and connection to a regulated non-municipal drinking water system that is currently providing minimum treatment and has the operational capacity to handle the additional demand; or

- Disconnection from the existing source intake and connection to a municipal drinking water system that is currently providing minimum treatment.

The local Medical Officer of Health may give further instructions and may authorize resumption of normal use of the water once minimum treatment or a new communal source well is in place.

Immediate Provision of Minimum Treatment

It is the Ministry's position that there is virtually no alternative to the immediate provision of minimum treatment if any water sample reveals any of the contamination mentioned above.

If an owner disconnects from the existing source intake and is actively pursuing options for a different source of supply, as discussed above, the immediate provision of minimum treatment may not be warranted.

Appendix A - Well System Checklist

Know where your well is located - consult with a licensed well contractor about relocating if present site is poor

- Wells should be located at a site where the elevation is higher than the immediate surrounding area
- Wells should be located at a site where the well is accessible for cleaning, treatment, repair, testing, inspection, and visual examination
- Wells should not be located inside well pits or in other locations that are prone to flooding or surface water contamination
- Bored or dug wells or any other wells without watertight casings to a depth of 6 metres below ground level should be located at least 30 metres from septic systems and other pollution sources

Wells with watertight casings to a minimum depth of 6 metres below ground level should be located at least 15 metres from septic systems and other pollution sources

Extend the casing above grade, if buried.

- The casing of a properly constructed well should extend a minimum of 40 cm above grade.

Inspect the cover or sanitary seal for cracks and holes

- All seals should be watertight and in good condition
- The cover should be commercially manufactured, vermin-proof, and should be able to prevent the entry of surface water and foreign materials

Contact a licensed well contractor to inspect the inside of the well

- The casing should be clean, free of contamination and watertight - look for signs of surface water seeping or running freely into the well, and look for seepage through cracks or stains on the inside of the casing;
- Check the seal around the plumbing inlets - replace the sealing material if it is in poor condition or if water is seeping in from outside the well;
- Remove any debris floating in the well and prevent further debris from entering the well;
- Compare your well construction to diagrams that show proper design and maintenance techniques - correct any problems you discover;

Check the condition of the air vents:

- Air vents should extend above the land surface to a height that would prevent the entry of flood water from any anticipated flooding in the area;
- The open end of the air vent should be shielded and screened to prevent the entry of foreign materials into the well;
- The air vent should be kept free of obstructions and blocks at all times.

Inspect the area around the well:

- Make sure this area is in a neat and sanitary condition;
- Ensure all potential contamination sources, such as animals, fuel, and equipment, are away from the top of the well;
- Look for settling of the ground around the outside of the well casing;
- If there is no slope or if some of the area has settled, mound the earth around the outside of the well casing so that it is tight, and so that water runs away from the well.
- Maintain a permanent buffer of grass or other vegetation extending at least 150 centimetres from the well casing in all directions

Ensure that all wells that are no longer in use are properly plugged and sealed by a licensed well contractor:

- All legal requirements under Regulation 903 must be adhered to, including the use of a suitable sealant that precludes the vertical movement of any water, contaminant, or other material between aquifers or between an aquifer and the ground surface.

Check your distribution lines - contact a plumber or licensed well contractor if repairs are needed:

- Monitor for leaks, corrosion and scaling in pipes, decreases in water pressure, dead-ends, and unexplained increases in water usage;
- Look for wet areas, greener vegetation, or melted snow along distribution lines to locate potential leaks;
- Ensure that any leaks, dead-ends, or other mechanical difficulties and equipment failures have been fixed;
- Eliminate any cross-connections through the use of gaps, breakers or other backflow prevention strategies or devices.

Appendix B - List of Questions for Use in On-site Investigation²

The following checklist of questions may assist in the investigation to determine preferred long-term remedial options. These questions are not listed in order of priority. The questions investigated will depend on the type and scope of the water system and the specific circumstances triggering the investigation. This is not intended to be an all-inclusive list as additional questions or factors may need to be considered depending on local circumstances.

- Is the water source vulnerable to contamination?
- Where is the raw water source located?
- Is the well-head located near a body of surface water?
- Do you suspect that the groundwater supply may be subject to the influence of surface water?
- Is the watershed or water recharge area subject to possible contamination from:
 - livestock operations
 - sewage or sanitary discharges
 - heavy recreational use?
- Is it a drilled or bored well with a watertight casing of minimum 6 metres depth?
- Is it a dug well or other shallow well without a watertight casing of minimum 6 metres depth?
 - Was proper sample procedure followed?
- What sample collection locations were utilized? Were they appropriate? Are they representative of the whole system?
- Was the faucet free of screen or other attachments?
- Did sampler wash hands prior to taking sample?

² Adapted from Draft 6 "Implementation Guidelines for Boil Water Advisories", January 28, 2002, prepared by the Boil Water Advisory Task Group, Council of Medical Officers of Health of Ontario and Association of Supervisors of Public Health Inspection of Ontario, p.23-26.

Was the cold water run for 2 - 3 minutes prior to sampling?

Were bottle and cap handled appropriately during procedure?

Was the sample properly refrigerated?

Was sample transported to laboratory within 48 hours?

Is there a history of high bacteriological quality water sample results?

Is there any history of adverse results from the distribution system?

For the previous three sampling periods:

How many samples were taken?

When were samples taken?

Where were samples taken?

What are the results of all of the samples (including both positive and negative results)?

Have there been any recent major changes to the source water quality (i.e. in the last month)?

Have there been any recent sewage or manure spills?

Have there been any recent heavy rains or flooding?

Has the watershed been experiencing any drought conditions?

Has there been any nearby intensification of recreational water use such as boating?

Has there been any undue demand on the source water?

Have there been any other circumstances noted that could cause deterioration in source water quality?

Have there been any changes/problems with operation of the distribution system?

Have any mechanical difficulties or equipment failures occurred?

Have there been any operational deficiencies?

Has there been any period where testing of the system was not carried out according to requirements?

- Have there been any recent disruptions in the system?
 - low pressure or main breaks
 - cross-connections
 - recent construction
 - stagnant water (dead ends)
- inadequate flushing
 - age and condition of pipes
- bio-film presence
 - What corrective actions have been initiated?
- Has the system been temporarily disinfected according to correct procedures?
- Have distribution pipes been flushed thoroughly in the affected area?
- Have water resamples been taken as required (a minimum of three samples per positive site)?
 - one sample collected at the affected site
 - one sample collected at an adjacent location on the same distribution line
 - one sample collected upstream on a feeder line toward the water source

Vulnerability of Population Served

- Does the system serve a sensitive population such as children, elderly, or those with certain medical conditions (e.g. children's summer camp, senior's community centre)?
- Does the water system serve large plants/factories involved in the processing of food, beverages or other water related products (e.g. commercial ice makers)?
- Does the water system serve large groups of recreational users (e.g. recreational camps, resorts)?
- Does the water system serve large transient populations for special events (e.g. Special Olympics Events)?

Appendix C - Procedure for Manual Disinfection of a Ground Water System

Temporary disinfection of a ground water system is required when poor bacteriological results occur, when contamination is suspected (e.g. after a flood), and at the beginning of each operating season. This type of disinfection is usually carried out by creating a concentration of at least 50 mg/L of chlorine throughout the well and distribution system and maintaining it over a contact time of 12 hours. Manual disinfection is necessary where systems do not already have stand-by chlorine disinfection equipment installed.

Manual disinfection of ground water systems is most commonly done using ordinary household bleach (see 'Method for Calculating Amount of Bleach Needed' below). Use a fresh unscented liquid bleach product containing 5% to 5.25% sodium hypochlorite.

Before disinfecting the water distribution system, remove or isolate any carbon filter from the system since carbon will tend to remove the chlorine. In addition, water heaters and storage tanks should be turned off, completely drained, and allowed to fill with chlorinated water. It is not necessary to drain and disinfect tanks and pipes that are connected to a furnace as part of a water or steam-based heating system.

Once the required amount of bleach has been added to the well, start feeding the chlorine solution through the distribution system. Open all the taps until you can smell chlorine and then turn the taps off. This will thoroughly chlorinate the plumbing fixtures. If there are any taps on the system where chlorine smell can not be detected add more bleach into the well until a chlorine smell is present and then turn the taps off. Allow the high chlorine solution to sit in the system for about 12 hours.

After 12 hours, discharge the water which has been sitting in the distribution system. Flush all the taps in the system with new water until the smell of chlorine disappears. None of the water being flushed should be allowed to enter the septic tank and the tile field. Entry of this water into the septic system may damage or cause the complete failure of the system. Although some chlorine may still be present in the system after flushing is completed, this will not be harmful.

After 48 hours, resample the distribution system for bacteriological indicators. The procedure for manual disinfection should be repeated until the relevant indicator of adverse water quality is not detected in two consecutive sets of samples. Do not resume normal use of the water until authorized by the local Medical Officer of Health.

Chlorination can effectively disinfect a well and water system. However, unless the source of the bacteria problem is found and corrected the problem will continue to recur. In some cases, a new well may have to be constructed to correct the problem.

Method for Calculating Amount of Bleach Needed

The **depth of water** in the well will be somewhat less than the **total depth** of the well. For the following calculation, use the depth of water, if known; otherwise use the total depth of the well. The total depth may be found on the well record.

Using Table 1, estimate the volume of water in the well, and the amount of bleach required.

Table 1: Volume of Bleach Required Per Metre of Water Depth at 50 mg/L Chlorine Dosage

Well Diameter (inside diameter of casing)	Volume of Water per metre of Water Depth	Volume of Bleach Needed to Disinfect Each Metre of Water Depth
5 cm (2")	2 L	2 mL
10 cm (4")	8 L	8 mL
12.5 cm (5")	12 L	12 mL
15 cm (6")	18 L	18 mL
17.5 cm (7")	24 L	24 mL
20 cm (8")	32 L	32 mL
60 cm (2')	300 L	300 mL
75 cm (2.5')	450 L	450 mL
90 cm (3')	650 L	650 mL

Note: A normal household measuring cup holds about 250 mL.

To obtain the final quantity of bleach to be added to the well, multiply the value in the final column by the number of metres of water depth:

Examples:

A drilled well with 15 cm diameter and water depth of 50 m would use 900 mL of bleach for manual disinfection.

($18 \text{ mL} \times 50 = 900 \text{ mL}$).

A dug well with diameter of 90 cm and water depth of 12 m would use 7.8 L of bleach for manual disinfection.

($650 \text{ mL} \times 12 = 7800 \text{ mL}$ or 7.8 L).

Instead of using Table 1, you can also use the direct formula, if desired:

1. A simple formula for estimating the approximate volume of household bleach to be added to well water to obtain 50 mg/L available chlorine is given below:

$$V = 0.08 \times D^2 \times H$$

Where:

D = inside diameter of the well casing in centimetres

H = depth of water in metres

V = volume of bleach that must be added in millilitres

0.08 = constant factor

2. Knowing the diameter of the inside of the well casing and depth of water in the well, calculate the number of millilitres of bleach to be added to the well water for achieving a dosage of 50 mg/L.

Examples:

A drilled well with 15 cm diameter and water depth of 50 m would use 900 mL of bleach for manual disinfection.

($V = 0.08 \times 15^2 \times 50 = 900 \text{ mL}$)

A dug well with diameter of 90 cm and water depth of 12 m would use 7.8 L of bleach for manual disinfection.

($V = 0.08 \times 90^2 \times 12 = 7776 \text{ mL}$ or 7.8 L).

